

# **Ultra-Long Duration Balloon TDRSS Data Interface Product Plan**

**Version 1.0  
September 20, 1999**

# ULDB TDRSS Data Interface Product Plan

**Revision 1.0**

**September 20, 1999**

**Submitted by:**

**Signed 09/28/1999**

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## Table of Contents

<b>1.0 Introduction</b>	<b>1</b>
<b>1.1 Purpose</b>	<b>1</b>
<b>1.2 Background</b>	<b>1</b>
<b>1.3 Product Plan Review and Update</b>	<b>1</b>
<b>2.0 Customer Agreement</b>	<b>2</b>
<b>2.1 Customer Identification</b>	<b>2</b>
<b>2.2 Customer Goals and Objectives</b>	<b>2</b>
<b>2.3 Requirements</b>	<b>2</b>
<b>2.4 Deliverables</b>	<b>2</b>
<b>2.5 Necessary Customer Training</b>	<b>3</b>
<b>2.6 Medium for Product Delivery</b>	<b>3</b>
<b>2.7 Product Destination</b>	<b>3</b>
<b>2.8 Post Delivery Maintenance</b>	<b>3</b>
<b>2.9 Customer Supplied Elements</b>	<b>3</b>
<b>2.9.1 Funding</b>	<b>3</b>
<b>2.9.2 Test Environment</b>	<b>3</b>
<b>2.10 Customer Involvement</b>	<b>3</b>
<b>2.10.1 ULDB Project Manager</b>	<b>3</b>
<b>2.10.2 ULDB System Engineer and Balloon-craft Manager</b>	<b>4</b>
<b>2.11 Customer Communications</b>	<b>4</b>
<b>2.12 Authority for Changes</b>	<b>4</b>
<b>2.13 Acceptance Criteria</b>	<b>4</b>
<b>2.14 Customer Agreement Review and Update Process</b>	<b>4</b>
<b>3.0 Management Approach</b>	<b>5</b>
<b>3.1 General Development Approach</b>	<b>5</b>
<b>3.2 Resources Needed</b>	<b>5</b>
<b>3.3 Organization</b>	<b>5</b>
<b>3.3.1 Organization Chart</b>	<b>5</b>
<b>3.3.2 Team Charter</b>	<b>5</b>
<b>3.3.3 Scope</b>	<b>6</b>
<b>3.3.4 Roles, Responsibilities, Authority, Accountability</b>	<b>6</b>
<b>3.3.4.1 ULDB TDI PDL Engineer</b>	<b>6</b>
<b>3.3.4.2 Real Time Software Engineering Branch</b>	<b>6</b>
<b>3.3.5 Decision Making and Conflict Resolution Process</b>	<b>6</b>
<b>3.3.6 External Support</b>	<b>6</b>
<b>3.4 Team Interfaces</b>	<b>6</b>
<b>3.5 Development Facilities</b>	<b>6</b>
<b>3.5.1 Modifications of Existing Facilities and Schedules</b>	<b>6</b>
<b>3.5.2 Development of New Facilities and Schedules</b>	<b>6</b>
<b>3.5.3 Physical Security</b>	<b>6</b>
<b>3.6 Procurement</b>	<b>7</b>
<b>3.6.1 Procurement Needs and Dates</b>	<b>7</b>

<b>3.6.2 Reference Procurement Process.....</b>	<b>7</b>
<b>3.7 Training Plan.....</b>	<b>7</b>
<b>3.8 Risk Mitigation.....</b>	<b>7</b>
<b>3.9 Schedule .....</b>	<b>7</b>
<b>3.10 List of Controlled Documentation .....</b>	<b>7</b>
<b>3.11 Process for Process and Product Metric Analysis .....</b>	<b>7</b>
<b>4.0 Technical Approach .....</b>	<b>9</b>
<b>4.1 Hardware Development Plan .....</b>	<b>9</b>
<b>4.1.1 Major Activities .....</b>	<b>9</b>
<b>4.1.1.1 Prototype Phases and Production builds .....</b>	<b>9</b>
<b>4.1.1.2 Products Associated with Prototype Phases and Production builds.....</b>	<b>9</b>
<b>4.1.2 Development Methodology .....</b>	<b>10</b>
<b>4.1.2.1 Methodology .....</b>	<b>10</b>
<b>4.1.2.2 Development Environment.....</b>	<b>10</b>
<b>4.1.2.3 Utilized Standards .....</b>	<b>10</b>
<b>4.1.2.4 Utilized COTS Products and Tools .....</b>	<b>10</b>
<b>4.1.2.5 Prototype Phase and Build Strategy .....</b>	<b>10</b>
<b>4.1.2.6 Product Inspection and Test Approach .....</b>	<b>10</b>
<b>4.1.2.7 Acceptance Criteria and Objectives.....</b>	<b>11</b>
<b>4.1.2.8 Reviews Planned .....</b>	<b>11</b>
<b>4.1.2.8.1 Requirements Analysis .....</b>	<b>11</b>
<b>4.1.2.8.2 Design Reviews.....</b>	<b>11</b>
<b>4.1.2.8.3 Status Reviews .....</b>	<b>11</b>
<b>4.1.2.8.4 System Readiness Review .....</b>	<b>11</b>
<b>4.1.3 Incoming Inspection and Test.....</b>	<b>11</b>
<b>4.1.4 Control of Test Equipment.....</b>	<b>12</b>
<b>4.2 Process for Transportation, Identification, and Medium of Product.....</b>	<b>12</b>
<b>4.3 Technology and Commercialization Plan.....</b>	<b>12</b>
<b>4.4 Servicing – Process for Product Maintenance.....</b>	<b>12</b>
<b>5.0 Product Assurance .....</b>	<b>13</b>
<b>5.1 Assumptions and Constraints .....</b>	<b>13</b>
<b>5.2 Quality Assurance .....</b>	<b>13</b>
<b>5.2.1 Control of Non-Conforming Products .....</b>	<b>13</b>
<b>5.2.2 Corrective and Preventative Action.....</b>	<b>13</b>
<b>5.2.3 Control of Quality Records .....</b>	<b>13</b>
<b>5.2.4 Control of Documents and Data.....</b>	<b>13</b>
<b>5.3 Configuration Management.....</b>	<b>13</b>
<b>5.3.1 Identification and Traceability of Products.....</b>	<b>14</b>
<b>5.3.2 Control of Customer Supplied Elements .....</b>	<b>14</b>
<b>6.0 Plan Update History .....</b>	<b>15</b>

## **1.0 Introduction**

This document is intended to describe the plan for the development of the Ultra-Long Duration Balloon (ULDB) TDRSS Data Interface (TDI). This document shall be the basis for formal agreements between the Balloon Programs Office and the ULDB TDI development team.

### **1.1 Purpose**

This document is intended to describe the plan for the development of the ULDB TDI. This document shall be the basis for formal agreements between the Balloon Programs Office and the ULDB TDI development team.

### **1.2 Background**

Recent advances in composite super-pressure balloon materials have greatly enhanced the prospects for very long duration balloon flights on Earth as well as possible use for planetary exploration. NASA is embarking on the development of technologies to support extended balloon missions lasting up to 100 days (~5 circumnavigations of the globe) above 99.9% of Earth's atmosphere.

The ULDB objective is to develop a low cost, integrated, advanced, long duration balloon system which is technically feasible and within program cost constraints while maintaining the existing balloon program. The ULDB program is significantly different from the current balloon program in that the expected science return is significantly greater than current balloon missions. In other words, it is more than simply extending current experiments over a longer time period. This program also expects to use technologies currently available in the spacecraft missions and commercial arenas to improve performance while containing costs.

The purpose of the ULDB TDI effort is to interface telemetry science, science housekeeping and balloon-craft housekeeping data received from the flight computer to the TDRSS transponder.

### **1.3 Product Plan Review and Update**

This document shall be reviewed and approved by the ULDB Project Manager and the ULDB Ballooncraft Project Manager. Concurrence shall be obtained from the Code 584 Branch Head and the ULDB Flight Software Lead.

This document has been developed by the ULDB Product Design Lead (PDL) of the ULDB TDI Team and shall be maintained by the ULDB TDI team. It may be updated to reflect changes in the project objectives.

## 2.0 Customer Agreement

This section describes the agreement between the ULDB TDI customer and the ULDB TDI PDL of the ULDB TDI Team including those issues related to requirements, deliverables, and maintenance of the TDI.

## 2.1 Customer Identification

The primary customer for the products developed by this effort is the Balloon Programs Office. The project has relevancy to the Earth Science Enterprise and the Space Science Enterprise as defined in NASA's strategic plan.

## 2.2 Customer Goals and Objectives

The customer's objective is to be provided with a TDI that processes data received and collected on the airborne instrumentation package. The flight software will facilitate all communications with the instruments on board and to the ground through continuous line of sight and over the horizon communications. The TDI will support a continuous data stream from the flight computer to the TDRSS transponder with a minimum bit rate range of 2 Kb/sec to 50 Kb/sec and a target bit rate range of 2 Kb/sec to 150 Kb/sec.

## 2.3 Requirements

The TDI is a derived requirement from section 3.3.1 entitled "Global Downlink" of the Design to Requirements Document (DTRD), document number 820-ULDB-DTRD-002.0, dated 10/16/98. This document can be found at the following web page <http://www.wff.nasa.gov/~uldb/documents.html>. The TDI is a PC-104 electronic board required to provide a buffering interface for data from the flight computer to the TDRSS transponder. The TDI is capable of performing a Bit Error Rate Test (BERT) for diagnostic testing and convolutional encoding data at rate  $\frac{1}{2}$  and constraint length = 7. A detailed description of the functional requirements and specifications of the TDI can be found in the Functional Requirements and Specifications document linked to the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface/index.html>.

## 2.4 Deliverables

The products to be delivered by the conclusion of this project are detailed below in table format. The Configuration Item (CI) number for the TDI is 3.3.1.6. The CI number is assigned by the project from the ULDB Project Plan located at <http://www.wff.nasa.gov/~uldb/documents.html>. The Product Breakdown Structure (PBS) numbering is annotated to the CI number.

PBS number	Description
3.3.1.6.1	CONUS TDI flight board #1
3.3.1.6.2	CONUS TDI flight board #2
3.3.1.6.3	CONUS TDI flight board spare #1
3.3.1.6.4	CONUS TDI flight board spare #2
3.3.1.6.5	Southern Hemisphere flight #1 TDI flight board #1
3.3.1.6.6	Southern Hemisphere flight #1 TDI flight board #2
3.3.1.6.7	Southern Hemisphere flight #1 TDI spare board #1
3.3.1.6.8	Southern Hemisphere flight #1 TDI spare board #2
3.3.1.6.9	Southern Hemisphere flight #2 TDI flight board #1
3.3.1.6.10	Southern Hemisphere flight #2 TDI flight board #2
3.3.1.6.11	Southern Hemisphere flight #2 TDI spare board #1
3.3.1.6.12	Southern Hemisphere flight #2 TDI spare board #2
3.3.1.6.13	TDI documentation including User's Guide, schematics, timing diagrams, and design documentation.
3.3.1.6.14	TDI prototype including board, development platform, and test results

Time frames and quantities of deliverables for the TDI can be found in the TDRSS Data Interface Schedule located at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>.

## **2.5 Necessary Customer Training**

The customer will receive training related to system installation and diagnostic operations.

## **2.6 Medium for Product Delivery**

Commercial Off-the-Shelf (COTS) incorporated into the product shall be delivered to the appropriate destination(s) as they are delivered from the vendor. The CONUS and Southern hemisphere TDI flight boards shall be an electronic board that conforms to a PC-104 form factor footprint. Items on the board shall consist of at a minimum an FPGA, 2 FIFOs, an 8-bit switch, and a Quad RS422 line driver.

## **2.7 Product Destination**

The TDI board(s) shall be installed in the ULDB flight computers on a PC-104 platform for the CONUS and southern hemisphere missions. The prototype shall be reside with the customer.

## **2.8 Post Delivery Maintenance**

Maintenance of the ULDB TDI will be the responsibility of the ULDB TDI PDL of the TDI team. All modifications to the ULDB TDI including bug fixes, enhancements, and upgrades will be performed by or managed by the ULDB TDI PDL. The TDI team shall perform maintenance of and modifications to the TDI board(s). Changes to the TDI board can be requested by using the ULDB TDI Request for Change form found on the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface/index.html>. Requested changes will be reviewed and must be approved by both the customer and the TDI development team before they are implemented.

## **2.9 Customer Supplied Elements**

This section describes those elements of the ULDB TDI development effort that are to be supplied by the customer.

### **2.9.1 Funding**

The customer shall provide all funding necessary to complete the project. This includes funding for all hardware, software, personnel, and facility equipment required for the project. A budget detailing the funding requirements has been compiled and is available upon request from the ULDB TDI PDL.

### **2.9.2 Test Environment**

The customer shall provide test equipment and a test facility for the integration, test, and verification of the TDI board. The test equipment will exercise, to the greatest extent possible, all of the data acquisition, buffering, processing, addressing, and clock & data configuration of the TDI board.. Test equipment shall include but is not limited to Logic Analyzer, Oscilloscope(s), TURFs test set, multimeter(s), and Portable PC lunchbox.

## **2.10 Customer Involvement**

The customer shall be the primary point of contact for the development of a concise list of requirements and functional specifications. Throughout the development of the TDI the customer will continue to serve as a point of contact for questions regarding detailed requirements and operation concepts. The customer shall review all documentation, including requirements and design reports.

### **2.10.1 ULDB Project Manager**

Steve Smith, Code 820 ([Ira.S.Smith.1@gsfc.nasa.gov](mailto:Ira.S.Smith.1@gsfc.nasa.gov))

The ULDB Project Manager is responsible for establishing the requirements to be met by the effort. In addition, it is the Project Manager who has final authority over the acceptability of the deliverable and will approve of change in scope, acceptability of levels of risk, and modifications to schedule ULDB Systems

### **2.10.2 ULDB System Engineer and Balloon-craft Manager**

David W. Stuchlik, 822 ([David.W.Stuchlik.1@gsfc.nasa.gov](mailto:David.W.Stuchlik.1@gsfc.nasa.gov))

The ULDB Balloon-craft Manager is the primary point of contact for specific technical issues regarding the ULDB balloon-craft. The Balloon-craft Manager provides guidance with respect to the specific technical performance of the new system against the requirements specified by the ULDB Project Manager.

## **2.11 Customer Communications**

Communication with the customer will be carried out in a variety of forms. The TDI PDL will make regular contact with the customer in order to report status, bring up development issues, and discuss design decisions. A report describing the project status, recent accomplishments, near-term plans, and problems encountered will be delivered to the customer at the end of each month.

## **2.12 Authority for Changes**

All changes to the requirements for the project required or requested by the customer should be requested using the ULDB TDI Request for Change form found on the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface/index.html>. Requested changes will be reviewed and must be approved by both the customer and the development team lead before they are implemented. Electronic forwarding of requirement changes via e-mail is preferred. If changes in requirements will result in a change in the TDI development schedule, the customer will be informed of the estimated impact promptly.

All changes to the design or implementation of the project required or requested by the ULDB TDI team that may have schedule impacts will be forwarded to the customer in writing. Written authorization for or concurrence with the proposed change by the customer will be required.

## **2.13 Acceptance Criteria**

The product will be determined to be complete when the customer accepts it. A formal release form signed by the ULDB TDI Team, the ULDB Project Manager, and the ULDB Balloon-craft Manager will become a part of the project's quality records.

The TDI team will provide supporting evidence of the product's readiness for acceptance. A verification checklist will be created and the TDI team will complete this checklist during project integration and test period. The Test and Verification Matrix, is linked to the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>. A demonstration of the TDI will be performed during integration and test. This demonstration will exercise all features of the system that correspond to the documented TDI requirements and functional specifications.

## **2.14 Customer Agreement Review and Update Process**

Either the customer or the TDI team may initiate changes to the requirements. All changes must be requested using the ULDB TDI Request for Change form found on the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>. Requested changes will be reviewed and must be approved by both the customer and the development team before they are implemented. A database will be created to track the requested changes. The signed Request for Change forms will be preserved by the development team.

### 3.0 Management Approach

This section describes the management approach that will be employed in the ULDB TDI board development effort.

#### 3.1 General Development Approach

The general development approach of the ULDB TDI will use Commercial Off-the-Shelf (COTS) and Government Off-the-Shelf (GOTS) products. Specifically, products that have been successfully employed for similar projects will be evaluated and reused for this effort.

The design, fabrication, and testing of a PC-104 interface for the TDI will be integrated and tested in parallel with the ULDB Flight Software development effort.

#### 3.2 Resources Needed

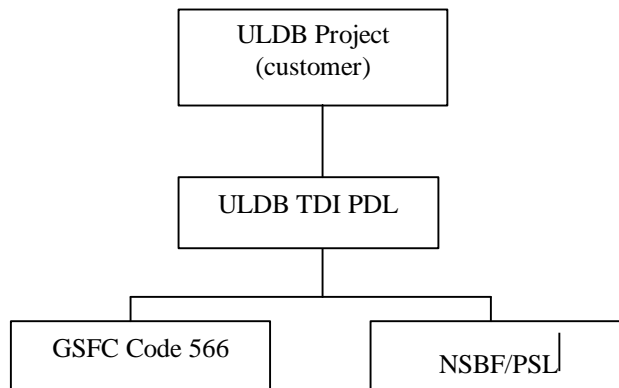
The development of the ULDB TDI is not to exceed 1.5 full time equivalent(FTE) civil servants of NASA employees. Civil Service FTEs shall be supported from code 584 the Real Time Software Engineering Branch (RTSEB), code566Contractor for testing and LDB mission requirements shall be supported by the NSBF (National Science Balloon Facility). A formal request for code 566 support is detailed in a memo of agreement between the ULDB project managerand code 566.

#### 3.3 Organization

This section describes the organization and purpose of the ULDB TDI development effort.

##### 3.3.1 Organization Chart

The following chart depicts the organization of the ULDB TDI development team including its position relative to the customer.



##### 3.3.2 Team Charter

The ULDB TDI development team will provide a PC-104 flight electronics board to process, monitor, and control data received and collected from the flight computer to the TDRSS transponder. The TDI board must support a continuous data bit rate output range of 0 Kb/sec to 50 Kb/sec with a target bit rate range of 0 Kb/sec to 150 Kb/sec.

### 3.3.3 Scope

The ULDB TDI development effort will procure and/or develop all hardware and software necessary for the ULDB PC-104 TDI board.

### 3.3.4 Roles, Responsibilities, Authority, Accountability

This section describes the roles and responsibilities of the members and supporting organizations associated with the ULDB TDI development.

#### 3.3.4.1 ULDB TDI PDL Engineer

Dwayne R. Morgan, Code 584W ([Dwayne.R.Morgan.1@gsfc.nasa.gov](mailto:Dwayne.R.Morgan.1@gsfc.nasa.gov))

The ULDB TDI Product Development Lead (PDL) is responsible for design development, documentation of system and interface requirements, testing, verification, and deployment of the TDI. In addition, the ULDB TDI PDL Engineer may provide documentation of the product, status reports as required, and demonstrations of progress as available.

#### 3.3.4.2 Real Time Software Engineering Branch

Code 584W

The Real Time Software Engineering Branch, as the AETD provider of engineering support for this project will provide organizational support for all aspects of the TDI development effort. This support may include generalized development tools and development environments, documentation support, development computers, related training if available within the branch, augmentation of effort levels as required for development, internal reviews or audits, and software development standards and policies.

### 3.3.5 Decision Making and Conflict Resolution Process

Design decisions related to the ULDB TDI development will be made by all members of the development team. In the event of a conflict, the ULDB TDI PDL will have final decision making authority.

### 3.3.6 External Support

Contractor support has been obtained to supplement the design and development phases of the project.

## 3.4 Team Interfaces

The ULDB TDI development effort will interface with the ULDB flight software development team. An Interface Control Document defining the data, command, and status interfaces between the ULDB flight computers, The TDI and the TDRSS transponder will be generated and approved by each team member.

## 3.5 Development Facilities

The ULDB TDI will be developed at the Goddard Space Flight Center in building 23. Development will be conducted in both code 566's lab and in at least one of the offices.

### 3.5.1 Modifications of Existing Facilities and Schedules

No modifications to the facilities will be required for this effort.

### 3.5.2 Development of New Facilities and Schedules

No new facilities will be required for this effort.

### 3.5.3 Physical Security

The GSFC code 566 lab is a secured room. Offices in Bldg. 23 remain locked when not in use. All government computers are password protected and on a government owned network.

### 3.6 Procurement

This section describes the purchases planned for the project. The overall budget for the TDI can be found on the ULDB TDI snap server under ULDB TDRSS Data Interface/TDI Budget.xls

#### 3.6.1 Procurement Needs and Dates

Description	Purchase Date
CMOS Chips for Prototype and Flight TDI Board	February 24, 1999
48 Channel Programmable I/O PCI board	April 13, 1999
PC-104 board layout of TDI flight components	TBD
1 PC-104 Development Platform & options	TBD
Actel/Altera Chips	TBD
Lunch-Box PC for field testing	TBD
Crystal Oscillators	TBD

#### 3.6.2 Reference Procurement Process

Center wide processes will be used for all procurements. Purchases of hardware and/or software costing more than \$2500.00 will be accomplished using the Small Purchases System (SPS). An approved government credit card holder will accomplish purchases of hardware and/or software costing less than \$2500.00 as a credit card purchase. All purchases will be compliant with Federal Acquisition Regulations.

### 3.7 Training Plan

No team training is required for the ULDB TDI development effort.

### 3.8 Risk Mitigation

There are a number of risk factors associated with this effort. Management of these risks is the responsibility of the ULDB TDI PDL in conjunction with the other member of the ULDB TDI development team. The major risk is the schedule. The schedule for delivery of the ULDB TDI is aggressive. Mitigation of risk is anticipated by the use of off-the-shelf software/hardware and by the development team's drawing on the experience of LDB personnel. Reviews and status reports also mitigate risk based on current interpretations of requirements. Other risks are related to potentially unidentified, misunderstood, or changing requirements.

### 3.9 Schedule

The ULDB TDI development schedule shows the key steps and milestones associated with the development effort and are included on the ULDB TDI web page at

<http://www.wff.nasa.gov/~uldb/tdrssdatainterface/documents/tdischedule.pdf>

#### 3.10 List of Controlled Documentation

The list of controlled documents related to the ULDB TDI development effort will be available on the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface>.

#### 3.11 Process for Process and Product Metric Analysis

Metrics will be collected as defined in the ISC Product Development Handbook (580-PG-8730.4.1), Appendix E. Analysis of the collected metrics will follow the ISC standard assessment process for process improvement.

The process of the ULDB TDI development effort will be analyzed through regular reviews of the schedule, budget, and status of the subsystem. Peer reviews and project reviews are anticipated. The

product will be reviewed during formal testing. An Acceptance Test Plan for the effort is being developed and will be published on the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface>.

The schedule will be updated monthly; a log will be maintained to record descriptions and justifications for changes to the schedule. An Excel spreadsheet has been created to track costs for hardware/software and contractor support. The spreadsheet includes field for estimated expenses and actual expenses. Non-conformances will be recorded in a database. The database will include a description, a reason and a priority of each reported non-conformance. All system changes will be described and justified in a release notice. Release notices will be maintained with the ULDB TDI Quality records.

## 4.0 Technical Approach

This section describes the technical design approach that will be used to develop the ULDB TDI.

### 4.1 Hardware Development Plan

The approach to the development of the ULDB TDI will be to maximize the use of Commercial Off-the-Shelf (COTS) products as much as is feasible. Some legacy LDB digital design will be integrated into the new ULDB TDI. Fully Programmable Gate Arrays (FPGA) logic shall be used in the form of Altera or Actel chips to maximize board space on a PC-104 platform.

#### 4.1.1 Major Activities

This section describes the major activities planned in the development of the ULDB TDI. Three phases have been identified for the prototype development that includes TDI Design, Bench Testing and Verification, and CONUS Integration and Test. The southern hemisphere flights shall follow with a buildup of the required hardware, bench level testing, and final integration and test. For detailed information on the TDI development schedule see the ULDB TDI schedule on the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>

##### 4.1.1.1 Prototype Phases and Production builds

The prototype development of the ULDB TDI will be broken into the following three phases: Phase I: TDI Design, Phase II: Bench Testing and Verification, and Phase III: CONUS Integration and Test. Phase I is the development of the design and shall include definition of the requirements, design, Interface Control Document (ICD) definition, Product Plan, Test Plan and Configuration Control Documentation. Phase II is the bench level test and verification and shall include the prototype hardware buildup, test code development for prototype data flow testing, and test plan implementation. Phase III represents the integration and test of the TDI for the first ULDB test flight CONUS. Phase III represents the hardware buildup, integration of the TDI to the flight computer and TDRSS transponder, TURFs and environmental testing, and any necessary rework or enhancements.

The southern hemisphere flights represent the production builds of the TDI development effort. Packaging for these flights shall be PC-104 platforms that make use of FPGAs. Southern hemisphere production builds shall include flight board buildup, hardware and software testing of flight boards, and TDI integration and test with the flight computer and TDRSS transponder. Enhancements and modifications to the TDI shall be incorporated after each flight and a design review.

##### 4.1.1.2 Products Associated with Prototype Phases and Production builds

The prototype design phase (Phase I) shall be completed when the Critical Design Review (CDR) has been presented and the design accepted.

The prototype bench and verification test phase (Phase II) shall be completed when all hardware and software tools needed for test and verification have been obtained, successful implementation of data flows through TURFs and a PC based software test system completed.

The prototype integration and test phase (Phase III) shall be complete when the TDI has successfully met all the functional specification requirements while fully integrated into the flight computer and TDRSS transponder. The TDI acceptance test plan must have been successfully implemented, and the customer and the ULDB TDI PDL has signed a release form.

The southern hemisphere builds shall be complete when the TDI flight boards have successfully completed the integration and test sequence, acceptance test plan, and the customer, the ULDB TDI PDL have signed a release form, and all functional requirement specifications have been successfully met.

#### **4.1.2 Development Methodology**

This section describes the methodology that will be employed in the development of this product.

##### **4.1.2.1 Methodology**

The ULDB TDI will be developed using the waterfall methodology. The first product will be delivered as a functional PC-104 prototype for the CONUS flight. Southern hemisphere flight products shall be production based PC-104 flight boards. Periodic peer reviews will be conducted to verify the design.

##### **4.1.2.2 Development Environment**

The TDI will be developed using an HDL based compiler for Actel FPGA chips. The compiler shall be running on a PC using the Windows NT operating system to develop the ULDB TDI FPGA. View Logic shall be used to layout the schematic of the board for fabrication.

##### **4.1.2.3 Utilized Standards**

Data downlinked by the flight software into the TDI will conform to the Consultative Committee for Space Data Systems (CCSDS) format. The TDI board must conform to a PC-104 form factor mechanical platform. Outputs of the TDI that feed the TDRSS transponder utilize the EIA RS-422A electrical standard for voltage compliance.

##### **4.1.2.4 Utilized COTS Products and Tools**

Development will be aided by using software development tools such as an Actel FPGA software compiler and simulator and View Logic for schematic drawings. Hardware tools include the Actel/Altera programming card and chip module(s), Logic Analyzer, Oscilloscope, multimeter, 48 channel programmable digital I/O ISA card, and a portable lunchbox PC with Windows NT 4.0. The TURFs closed loop system shall be used to verify and decom data on a closed loop TDRSS network.

##### **4.1.2.5 Prototype Phase and Build Strategy**

The prototype phases are intended to step through a sequence of capabilities from initial design to flight integration and test. Each phase will provide significant functional capability. The build strategies are structured after a proven design and intended to minimize fabrication time and maximize integration and test cycles. These strategies are detailed in the TDI Development Schedule available at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>.

##### **4.1.2.6 Product Inspection and Test Approach**

Each component submitted or procured for integration into the ULDB TDI will be subjected to standard verification and validation procedures to insure compliance with security and year 2000 requirements.

All hardware design elements developed specifically for the ULDB TDI effort will undergo a peer review. Results of the peer review will be a quality record.

TDI testing will be the role of the ULDB TDI team. The TDI board will be tested against documented ULDB TDI functional specifications and requirements.

A TDI Test Plan will be available on the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>. Supporting evidence of the product's readiness for acceptance will be provided by the ULDB TDI team. A verification checklist has been created and will be completed during the project integration and test period by the ULDB TDI team. This checklist, the Test and Verification Matrix, is linked to the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>. A demonstration of the TDI will be performed during integration and test. This demonstration will exercise all features of the system that correspond to the documented system requirements.

#### **4.1.2.7 Acceptance Criteria and Objectives**

A verification checklist has been created by the ULDB TDI team and will be completed during the project integration and test period. The checklist is the Test and Verification Matrix and is linked to the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>.

#### **4.1.2.8 Reviews Planned**

The key components of the review cycle include a requirements analysis, to be performed and documented by the development organization, preliminary and critical design reviews, peer reviews, status review, and a system readiness review. The ULDB TDI PDL schedules peer reviews, while the ULDB Ballooncraft Manager schedules all other reviews. Reviews are noted on the schedule.

##### **4.1.2.8.1 Requirements Analysis**

The requirements analysis will identify project requirements and assess their completeness, clarity and correctness. The product of this analysis will be the [ULDB TDI Functional Requirements and Specifications](#) document. This document will be reviewed and signed by the ULDB Project Lead, the ULDB Systems Engineer and Balloon-craft Manager, the ULDB Mission and Operations Manager, and the ULDB TDI development team.

##### **4.1.2.8.2 Design Reviews**

Preliminary and Critical design reviews will assess the applicability of the specific system design and implementation plan. These reviews will provide an external view of the development effort and will insure that the implementation strategies and designs make maximum use and reuse of COTS and other off-the-shelf systems or technologies and minimize risks associated with the effort. The review panel will be made up of individuals selected by the Balloon Projects Office.

##### **4.1.2.8.3 Status Reviews**

Status reviews will be held as required by the project and will provide both project and management personnel with a current status of all aspects of the project. Each review will identify areas of progress, areas of completion, areas of lag, and changes to requirements, schedule, budget, or functionality to be delivered. The review panel will be made up of individuals selected by the Balloon Projects Office. Code 500, Applied Engineering Technology Directorate, shall conduct semi-monthly technical status reviews (TSR) to insure maximize use of resources and design completeness.

##### **4.1.2.8.4 System Readiness Review**

The System Readiness review will establish that the system design and implementation has met the requirements and can be released for operational use. The review panel will be made up of individuals selected by the Balloon Projects Office.

#### **4.1.3 Incoming Inspection and Test**

Kind, count and condition of purchased hardware products is planned. The Goddard Receiving, Inspection, and Test System (RITS) will be the primary tool to develop records documenting compliance with the requirements contained in the GPG4520.2.

#### **4.1.4 Control of Test Equipment**

Test equipment for the TDRSS network (TURFS) shall be used in integration and test of the TDI. Control of the test equipment will be the responsibility of the project providing the test equipment.

#### **4.2 Process for Transportation, Identification, and Medium of Product**

The NASA/GSFC center process for transportation will be used to transport all ULDB TDI products. Each TDI design release will have a unique version number for identification. The medium for product delivery was discussed in section 2.6 of this document.

#### **4.3 Technology and Commercialization Plan**

There is no technology and commercialization plan at this time.

#### **4.4 Servicing – Process for Product Maintenance**

Servicing of all COTS hardware and software will be covered under the respective product warranties. Servicing of all GOTS will be performed by the supplier. The ULDB TDI team will perform maintenance of integration on the ULDB TDI.

## 5.0 Product Assurance

This section describes the processes and procedures that will be followed in order to assure that the product developed satisfies the customer's requirements.

### 5.1 Assumptions and Constraints

It is assumed that all GOTS products employed in the ULDB TDI will be ISO-9001 compliant. The GOTS supplier is expected to maintain quality records related to the product. It is assumed that all COTS products will meet or exceed all specifications included in the purchase request.

### 5.2 Quality Assurance

This section describes the processes and procedures that will be followed in order to assure that the customer receives a quality product.

#### 5.2.1 Control of Non-Conforming Products

Prior to release and acceptance of the system, non-conforming products will be reported using the ULDB TDI Request for Change form found on the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>. Following release and acceptance of the system by the customer, changes will be tracked using the Center Level Non-Conformance Reporting (NCR)..

Reports of nonconformance will be reviewed, tracked, and maintained by the development team. An assessment of the impact of the nonconformance to the schedule, budget, and delivery of the product will be made by the development team and reported to the customer. Changes made to the system in response to a nonconformance report will be maintained by the ULDB TDI development team.

The customer will have the authority to use or refuse the product in an operational environment.

#### 5.2.2 Corrective and Preventative Action

Errors will be reported using the ULDB TDI Request for Change form found on the ULDB TDI web page. Reports of nonconformance will be reviewed, tracked, and maintained by the development team. An assessment of the impact of the nonconformance to the schedule, budget, and delivery of the product will be made by the development team and reported to the customer. Implementation of changes will be done according to the priority defined by the ULDB Project management.

All system changes will be verified using Test and Verification Matrix before system release.

#### 5.2.3 Control of Quality Records

All quality records associated with the ULDB TDI development effort will be controlled by the ULDB TDI PDL. A list of the quality records will be linked to the ULDB TDI web page at

#### 5.2.4 Control of Documents and Data

All documents generated by the ULDB TDI development team are controlled by the ULDB TDI PDL.

## 5.3 Configuration Management

Configuration management procedures will be applied to all components delivered or developed during this effort. Subsequent design builds or deliveries will result in incremental versions of the system. Changes to archived or installed hardware following the initial delivery must be requested using the ULDB TDI Request for Change form on the ULDB TDI web page at <http://www.wff.nasa.gov/~uldb/tdrssdatainterface.html>. All changes will be reviewed by the ULDB TDI development team. An estimate of the schedule and budget necessary to effect the requested change will be made and presented to the ULDB Project management.

**5.3.1 Identification and Traceability of Products**

A formal release form signed by the ULDB TDI development team, the TDI PDL, the ULDB System Engineer, and the ULDB Mission and Operations Manager will become a part of the project's quality records. The release form will include an identification of components that comprise the released product as well as any known constraints or restrictions.

**5.3.2 Control of Customer Supplied Elements**

Control of funding and test equipment shall reside with the customer.

**6.0 Plan Update History**

<b>Version</b>	<b>Date</b>	<b>Description</b>	<b>Affected Pages</b>
1.0	September 20, 1999	Original	All